Microplastics are everywhere, but their dangers largely remain a mystery, experts say

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Samuel Munoz, Northeastern professor of marine and environmental sciences and civil and environmental engineering. Credit: Matthew Modoono/Northeastern University

They are everywhere: in riverbanks, on glaciers, in deserts, in fish

populations, even in the air we breathe. And these are just a few of the places where scientists have found microplastics, plastic debris roughly the size of a sesame seed that move easily through the environment, the impact of which remains somewhat of a mystery, Northeastern University experts say.

Microplastics continue to be highlighted in the news for being discovered in various human body parts, including the lungs, blood, and even the placenta. These tiny particles result from bigger substances, mainly large plastic debris, breaking down. They pass easily through water filters, make their way into bodies of water, and potentially threaten aquatic life, according to the National Oceanic and Atmospheric Administration. And because plastics are made to remain durable, they take years to erode, and microplastics maintain a lasting presence on Earth.

"Plastic was designed to be a material that breaks down slowly, so it can certainly break down into smaller and smaller particles, but those particles don't disappear. They just get smaller and smaller and move around, no matter how much erosion happens," explains Samuel Munoz, Northeastern professor of marine and environmental sciences and civil and environmental engineering.

Munoz's area of study is geology, specifically how plastics and sediments move around the environment, where they get stored, and why they accumulate where they do. He notes that with countries' escalating plastic production for the past several decades, microplastics' prominence in ecosystems is an increasing concern. In 2017, more than 300 million tons of plastic was produced, compared to only 1.5 million tons in 1950, according to the International Union for Conservation of Nature.

"It's a growing problem, because our production of plastics has been

increasing since the 1950s and will increase in the coming decades, unless we change something," Munoz explains.

Part of the reason why plastic production is continuing to accelerate around the world is because of human reliance on fossil fuels. Plastic is made using waste from coal, crude oil, and natural gas, so it is incredibly cheap to produce, says Aron Stubbins, Northeastern professor of marine and environmental sciences, civil and environmental engineering, and chemistry and chemical biology.

"Plastic overproduction is a result of our reliance on fossil fuels to drive our industries. Producing cheap plastics is one of the ways we profit off the waste of fossil fuels," Munoz explains. "In terms of the scale of production, it's potentially alarming."

A significant concern, emphasized by the NOAA, is microplastics in the ocean, particularly because the percentage of these particles in the ocean represents only a small fraction of the actual plastic waste out there, Munoz notes. He says this raises the question: Where is all the waste going?

To try to answer this, Munoz and Stubbins are exploring how microplastics accumulate in floodplains next to rivers. In February, the professors submitted a proposal to sample a floodplain they have already studied, as well as its soil, to see how much plastic resides there.

According to Munoz, researchers in other parts of the globe, including Germany, have already studied microplastics in particular bodies of water, but he and Stubbins hope to add to the growing body of research on where these tiny particles accumulate and why.

"There's been other work done showing it's everywhere," Munoz says about microplastics. "They've found microplastics in glaciers, at the

bottom of the sea, in deserts, in every conceivable location. It's wild."

Despite the fact that microplastics have been found throughout the world, the dangers of these particles to human health, as well as the environment, is an area of much-needed research, Munoz, Stubbins, and other scientists agree.

"With respect to health, there's a lot we don't know," Stubbins says, noting, however, that exposure to any type of particle is detrimental to respiratory health. "Particles in general are bad for our respiratory system, so anything that adds particles to the air is bad for our bodies."

Beyond human health, researchers have detailed instances of aquatic animals ingesting microplastics and dying. The work of Northeastern professor Zhenyu Tian, an environmental chemist, has focused on how rubber tire particles, and the chemicals that leach out of them, make their way into rivers and harm salmon.

There are two ways in which microplastics, like rubber tire particles, can potentially cause harm, Tian explains: first, by breaking down and releasing contaminants used to make the plastic, like flame retardants and antioxidants; and second, by latching onto other harmful chemicals that already exist in the environment, like pesticides.

Unlike fish, humans have longer life spans, and microplastic exposure to people is incredibly complicated, so it is hard to study the substance's impact on humans, according to Tian. Still, the kinds of contaminants that leach out of and onto microplastics are generally not good for our bodies, he points out.

"It has to be recognized that many of these contaminants are bioactive in the human body," Tian says. "They have a harmful effect on the human body if the concentration is high enough."

There is also the concern, though unconfirmed, that even though these plastics are tiny, they could potentially cause blood clots or other physically damaging effects, Tian adds.

There is already research on the dangers of specific additives used to make plastics, like BPA, known to impact brains, fetuses, infants, and children. But that is only one chemical, and there is an assortment used to make plastics, Stubbins notes. Along with decreasing the production of unnecessary plastics to curb the potentially harmful effects of microplastics, greater regulations are needed to restrict what substances companies use to create plastics, he says.

"In the U.S., there's this 'beg-for-forgiveness,' rather than 'ask-for-permission' attitude toward companies putting certain chemicals in their products. It's only when there's a toxic impact identified that you get public pushback against it," Stubbins says. "If public safety, rather than profits, were the dominant concern, then you'd have to take each of those chemicals through checks before you use it. This would create problems for industry but would likely benefit public health."

More information: Zhenyu Tian et al, A ubiquitous tire rubber–derived chemical induces acute mortality in coho salmon, *Science* (2020). DOI: 10.1126/science.abd6951

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